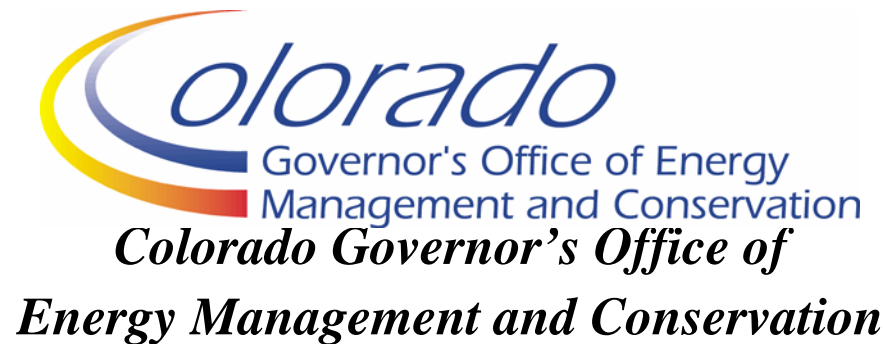


# *Energy Management Training for State Agencies and Higher Education*

## **Workshop #3: Technology Focus - Boilers**

**A Tele-Workshop brought to you by:**



*November 29, 2006*





## *Call Us When You ...*

- ✓ Are strategizing **to upgrade** your buildings
- ✓ Are **planning a new building**
- ✓ Are **developing projects** for capital improvement budgets (internal funds, bonds or grants)
- ✓ Want to **use energy savings to pay for projects**
- ✓ Want to **bring energy costs under control**
- ✓ Want to **improve comfort and solve maintenance problems**



# ***Your Rebuild Colorado State Government Team***

## **Working with Rebuild Colorado**

- **Linda Smith, OEMC Senior Program Manager (303-866-2264)**
- **Your State Department Liaison -Terry Yergensen (719-200-6609)**
- **Your Higher Education Liaison –Tom Cowing (303-772-4414)**

## **Rebuild Colorado Support Team**

- **Energy Management Specialists (Tom Cowing, Terry Yergensen, Peter D'Antonio)**
- **Utilities Specialists (Tom Cowing, Terry Yergensen)**
- **LEED Specialist (Peter D'Antonio)**
- **Training Program Coordinator (Peter D'Antonio)**
- **Commissioning Specialist (Peter D'Antonio)**
- **Performance Contracting Specialists (Peter Oatman, John Canfield)**

## **Working in partnership with Office of State Architect**







# **Boilers and Systems**

**Leonard Rozek, CEM, LEED-AP**

**E Cube Inc.**

**Boulder, CO    Chicago, IL**

**OEMC Presentation**

**November, 2006**



# OEMC Boilers

## ■ Introduction

- Leonard Rozek, CEM, LEED-AP
- 30+ years of HVAC  
Design/Engineering/Installation/Operational Experience
- Central Heating, Cooling and Power Plants
- Distribution Systems
- DDC
- Commissioning



# Definitions

## ■ Classifications

- Pressures – low or high (ASME)
- Steam or Hot Water
  - Control: Steam by pressure, water by temperature
- Fuel/Energy – NG, LPG(Propane), Liquid (Fuel Oil), Solid (Coal, Wood, Biomass, MSW), Electricity
- Primary Service
  - Commercial or Industrial
- Combustion Type



# Definitions

- Hot Water Boiler Types
  - Cast Iron Sectional







# Definitions

- Copper Fin Low Mass







# Definitions

- Condensing Boilers





# Definitions

- **Steam Boilers**

- Scotch Marine

- Firebox and Scotch Marine designs
- External shell is pressure vessel
- Steam unit generates only saturated steam
- Range from 10-1000 bhp (1 bhp=33,475 btuh)
- Many operate  $\leq 150$  PSIG, up to 350 PSIG available
- Versatile (space heat and process combination)



# Definitions

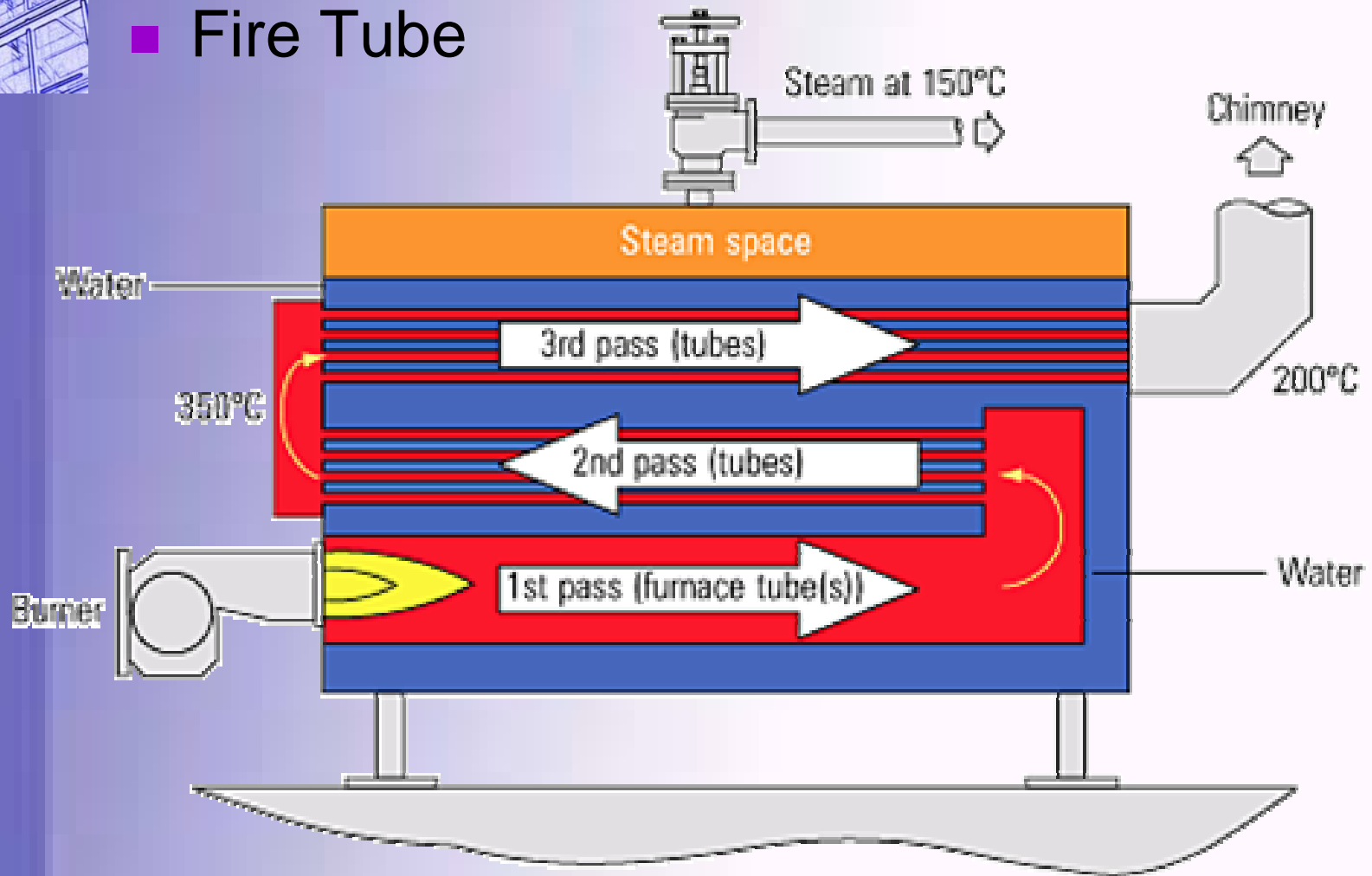
- Fire Tube





# Definitions

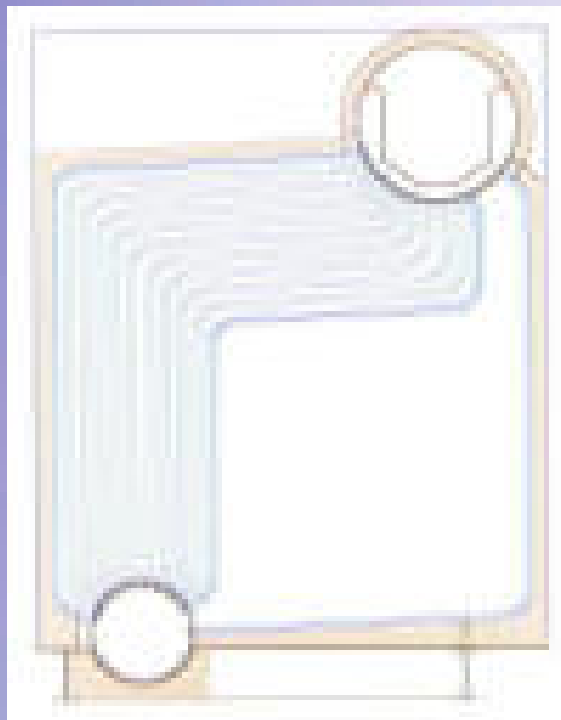
## ■ Fire Tube





# Definitions

- Drum Boiler

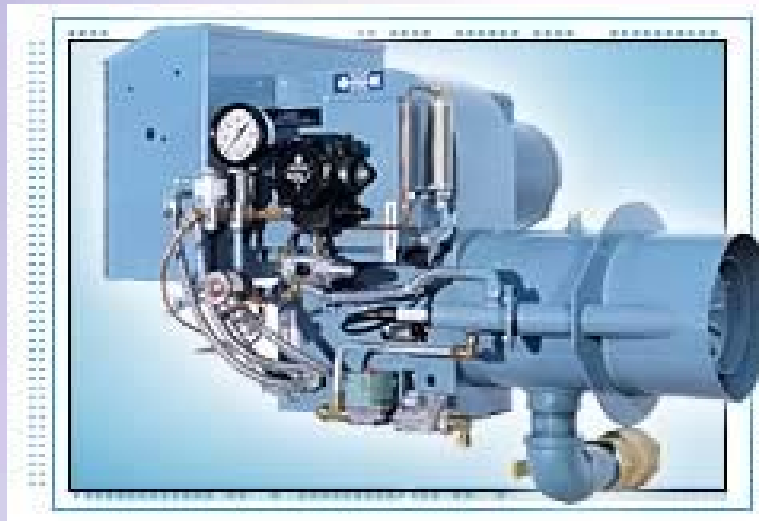






# Definitions

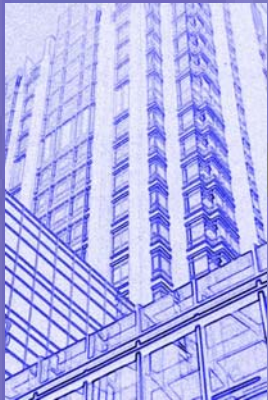
- Combustion Types
  - Atmospheric
  - Sealed
  - Condensing
  - Power Burner/Dual Fuel





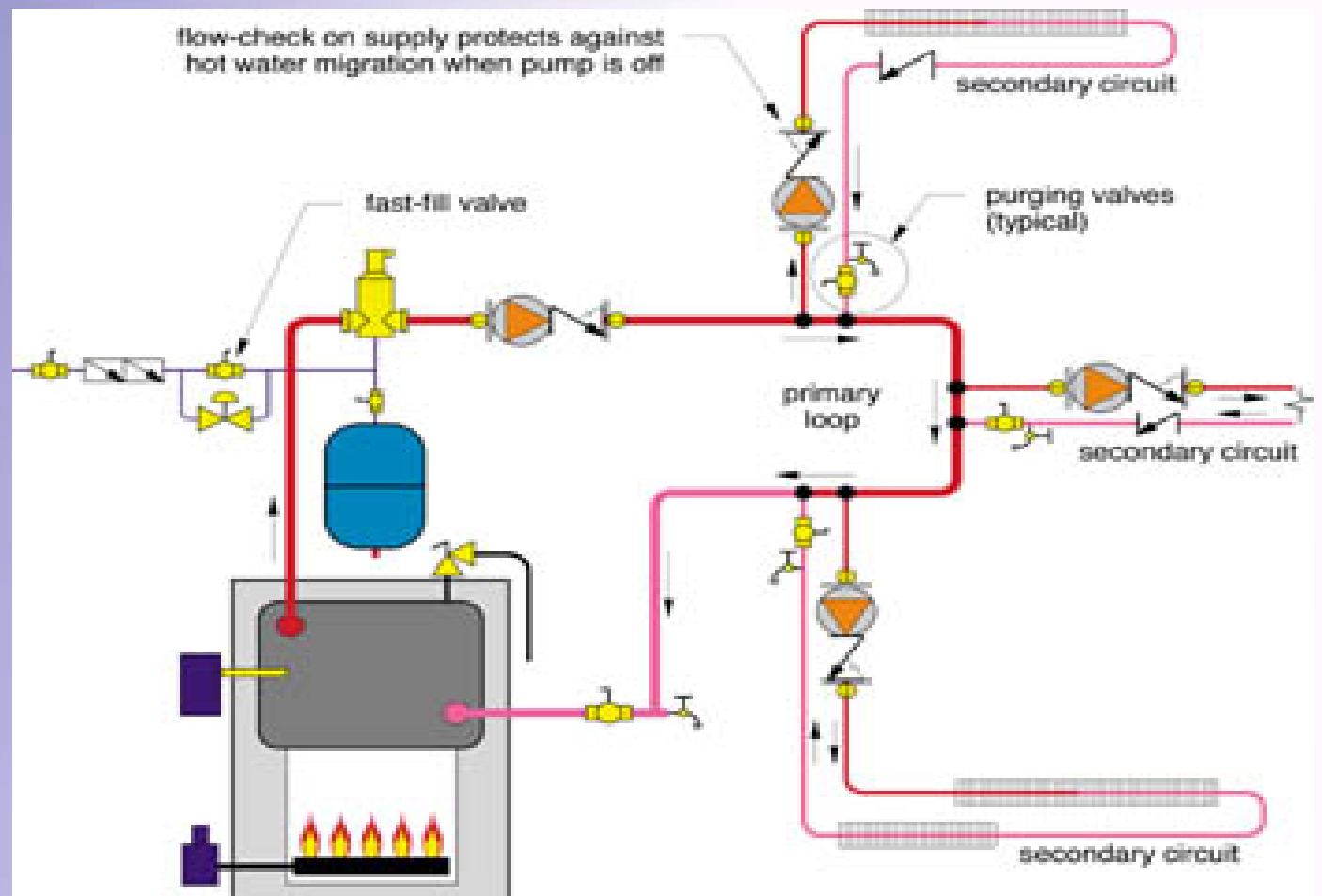
# Definitions

- Delivery Systems – Hot Water
  - Primary
  - Primary/Secondary
  - Primary/Injection
  - Primary/Secondary/Tertiary (coil pumps)
  - Steam/Hot Water Conversion
  - Steam Distribution
    - Gravity Condensate Return
    - Pumped Condensate Return
      - Electric
      - Steam



# Definitions

## ■ Primary/Secondary



OEMC Boilers



# Efficiency

- EPAAct 1992 – Minimum Combustion Efficiencies
  - MCE gas-fire boiler >300,000 Btuh is 80%
  - EPAAct 1996 82%
  - Most non-condensing boilers are 80%-86% efficient range
  - Condensing boilers 92%-99% efficient



# Efficiency

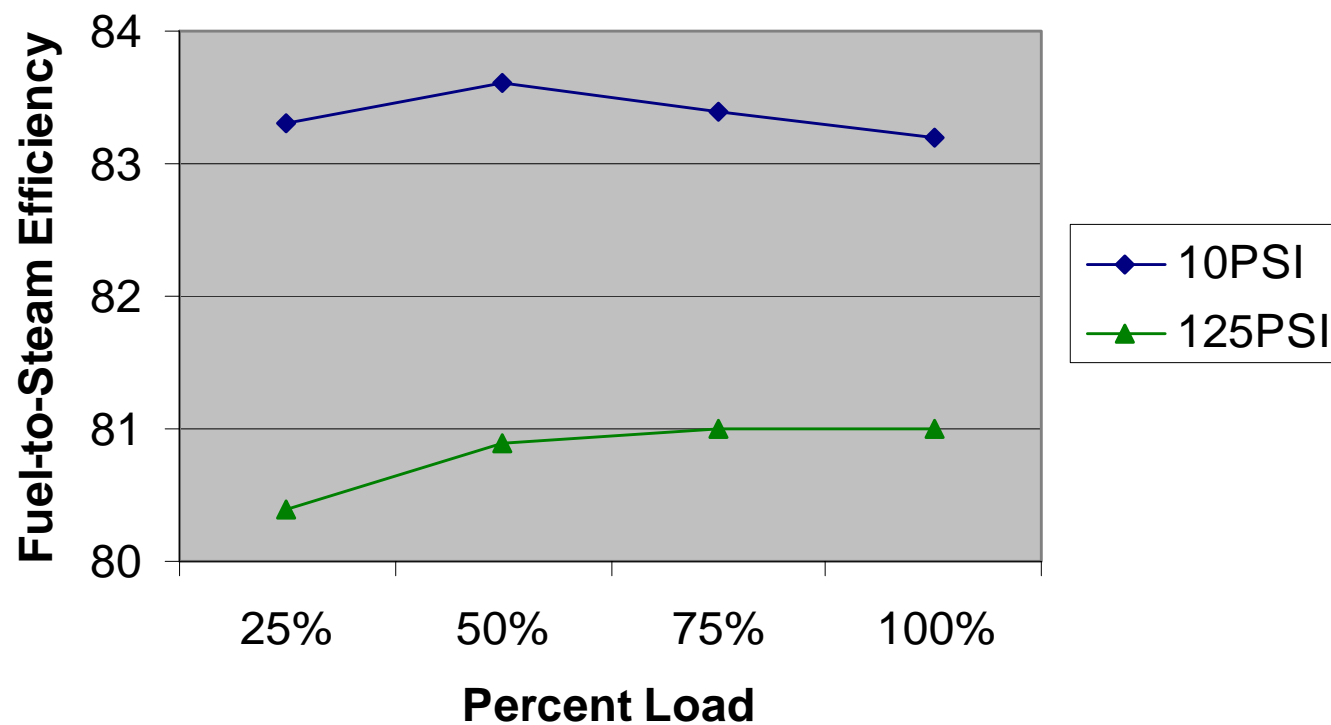
- Efficiency, Boiler efficiency
- Combustion efficiency - how efficiently the boiler burns the fuel.
- Steady-state efficiency - how efficiently the boiler uses the heat from combustion when operating under full load.
- Operating efficiency - efficiency of a boiler when operating at a fixed condition.
- Fuel-to-steam efficiency - combustion efficiency minus convection/radiation loss.
- **Seasonal efficiency - how efficiently the boiler uses fuel over the entire heating season.**

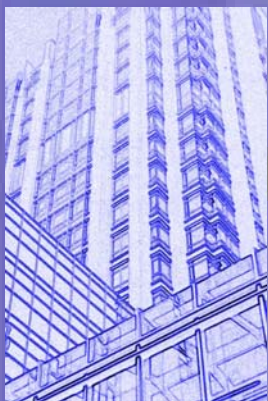




# Efficiency

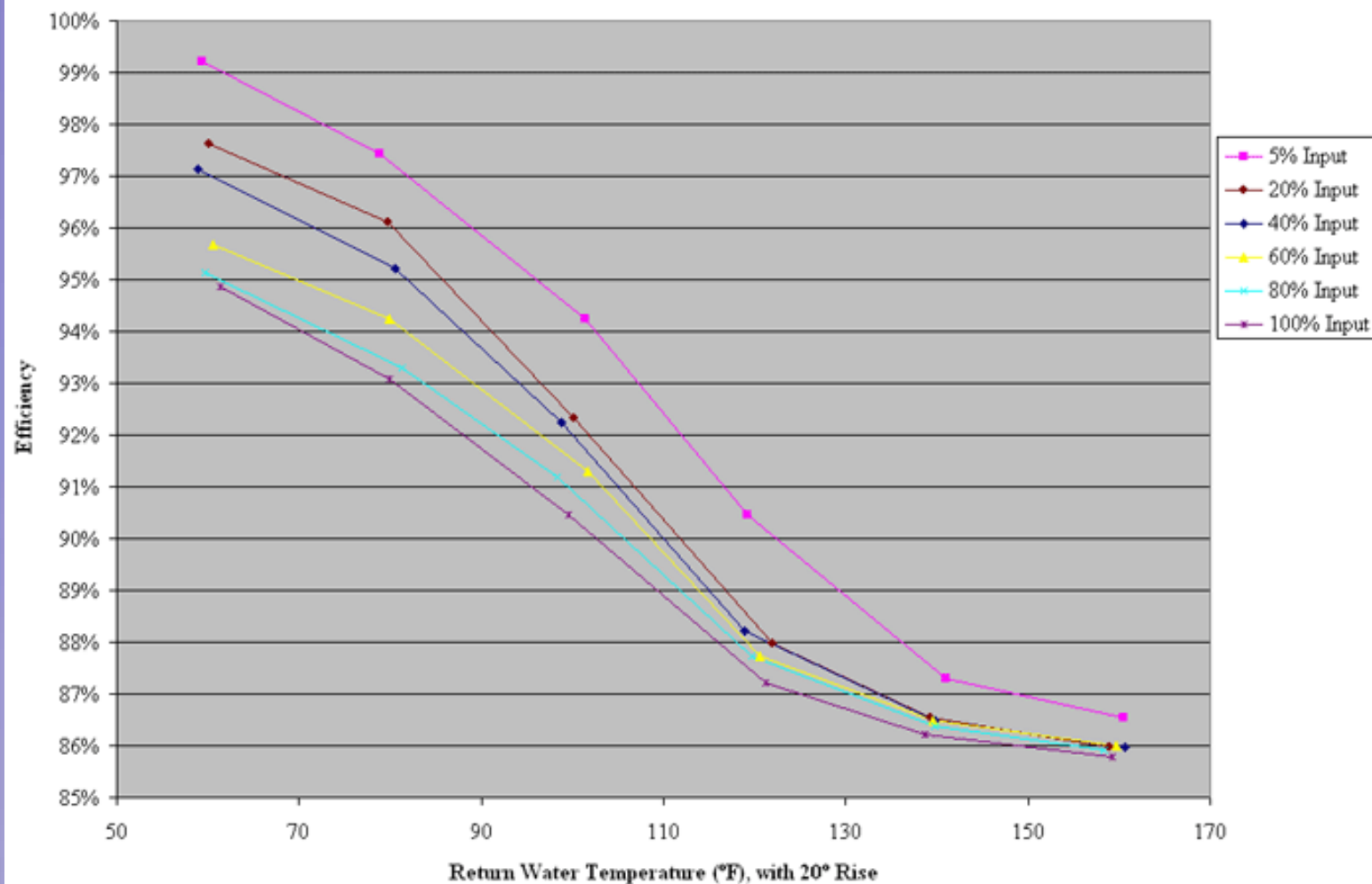
## Horizontal Firetube Boiler, 4-pass, 125HP





# Efficiency

Thermal Efficiency of BMK2.0LN





# System Upgrades

- Variable Flow Pumping
- OA Reset
- Stack Heat Reclaim
- Flue Damper
- Fire Tube Turbulators
- Separate Hot Water Heaters
- O2 Trim
- Burner Upgrade



# System Upgrades

- Pipe Insulation
- Excessive Pumping
- Pump Sizing
- Coil Pumps
- Glycol Mixture
- Burner Trim
- Boiler Controls/Multiple Boilers



# O&M Considerations

## ■ Burner Trim

### ■ Excess O<sub>2</sub>

- Note adjustment  
CO level rise
- Burner Clean
- Flame Stability
- Stack  
Temperature
- Soot







# O&M Considerations

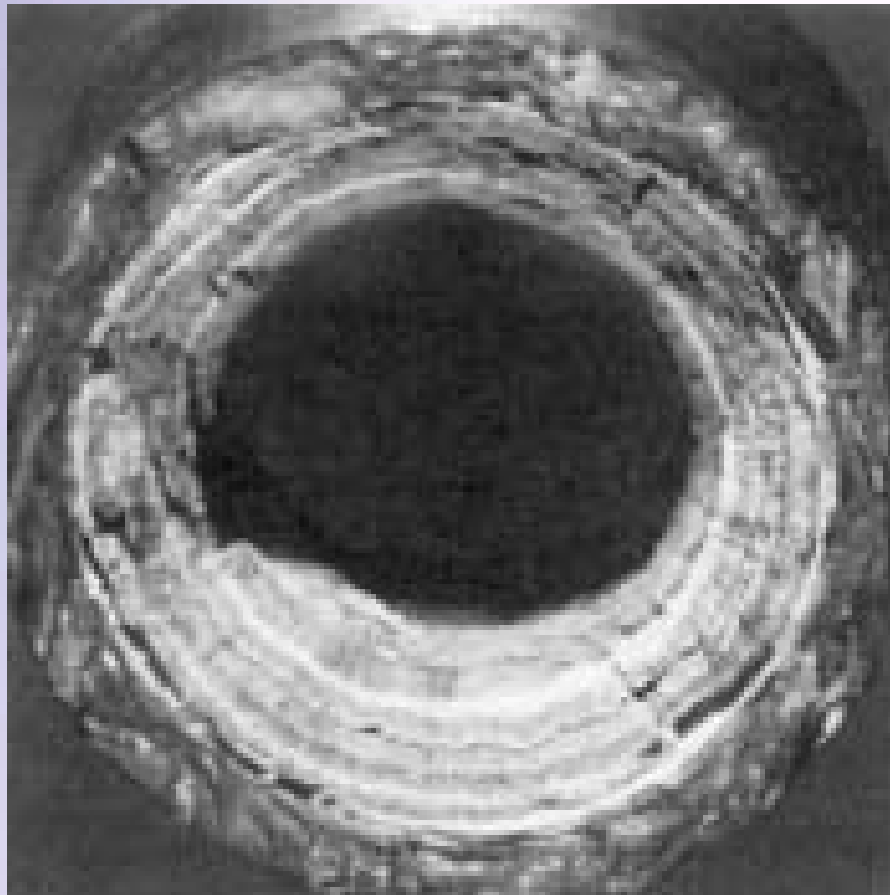
- Fire Tube Cleaning





# O&M Considerations

- Water Treatment





# O&M Considerations

- Steam Trap Survey





# O&M Considerations

- Boiler Controls





# Boiler Replacements

- Number #1 Rule
  - Know your load!
- Number #2 Rule
  - Know your seasonal load profile!
- Number #3 Rule
  - Know your operating temperatures!





# Boiler Replacements

## ■ Selection Criteria

- Codes and standards requirements
  - Steam or hot water
- Boiler load – type & size
- Number of boilers – backup, downtime
- Performance considerations
  - Fuels, emissions, efficiency
- Special considerations

Distance from load to plant

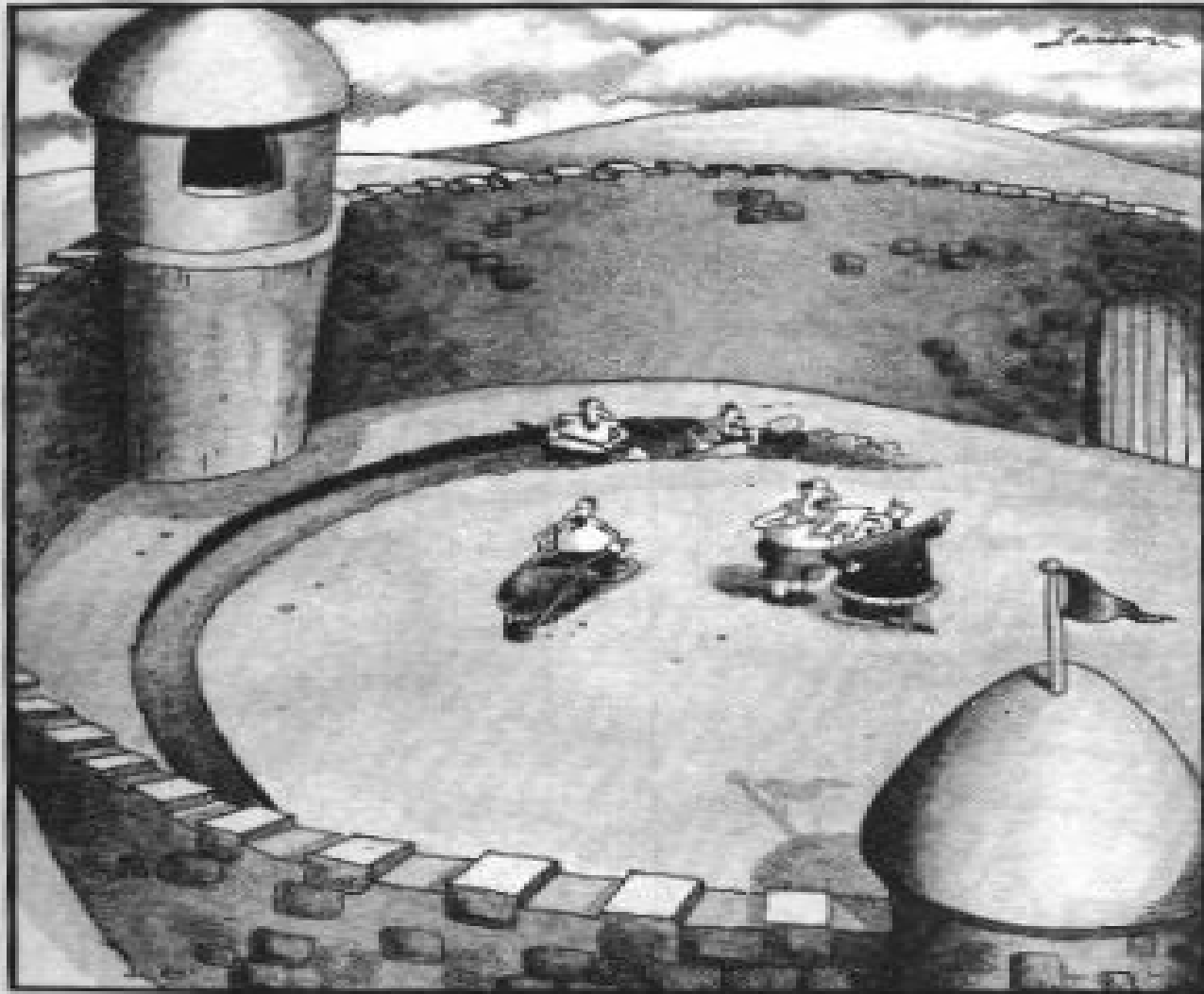
Operating personnel experience

Space and other boilers

characteristics



# Commissioning Process



**Suddenly, a heated exchange took place between the king and the moat contractor.**

Nov., 2006

OEMC Boilers

27



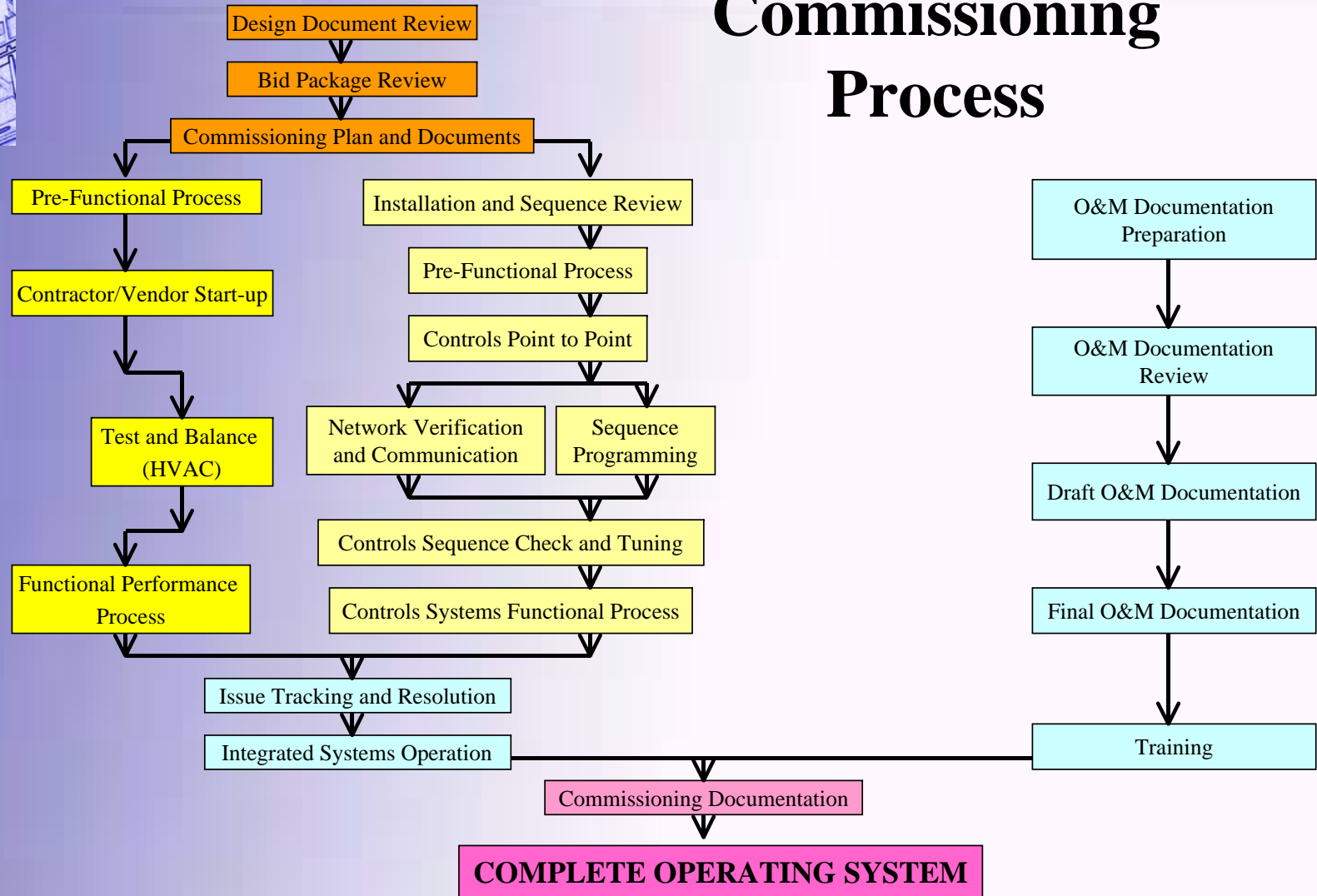
# Commissioning Process

- **Commissioning is the process of ensuring that mechanical, electrical and other building systems are installed, tested, and perform interactively in accordance with the design documents. This systematic process provides an independent verification that systems are functioning properly, as designed, and as required for a complete operating system.**
- **The commissioning process provides the means to integrate the owner's facilities staff into day-to-day operation of the various systems. This interactive process enables the staff to keep track of system functionality testing leading up to final acceptance. Additionally, commissioning offers a mechanism for raising key operational issues and having them documented and addressed.**



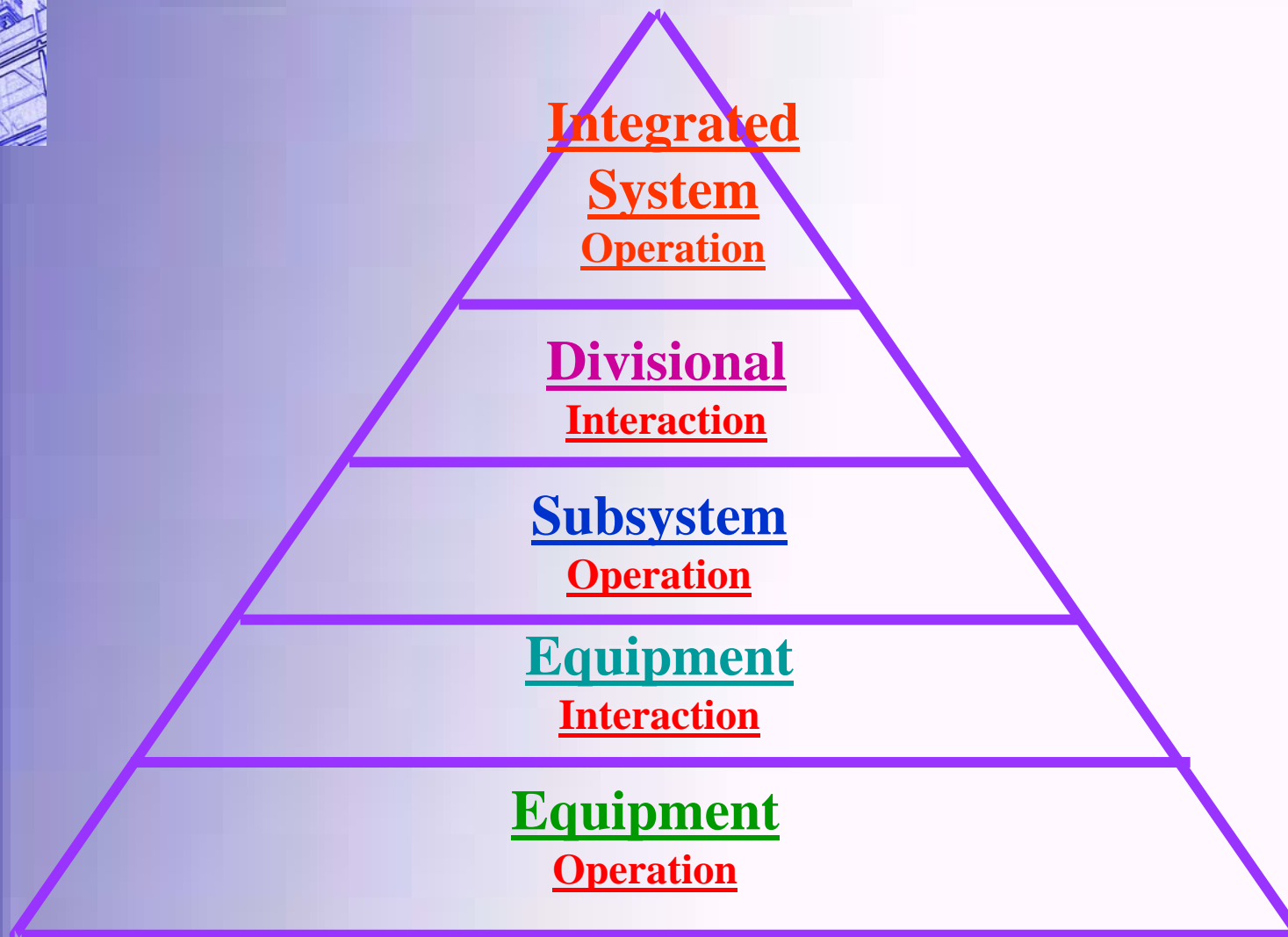
# Commissioning Process

## Commissioning Process





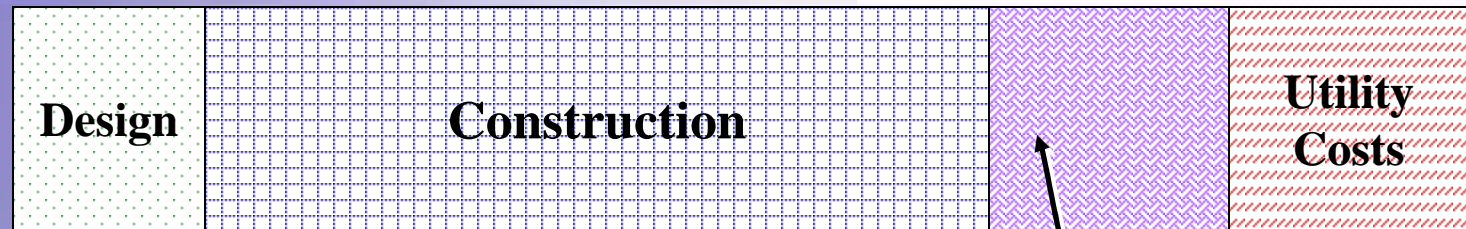
# Commissioning Process





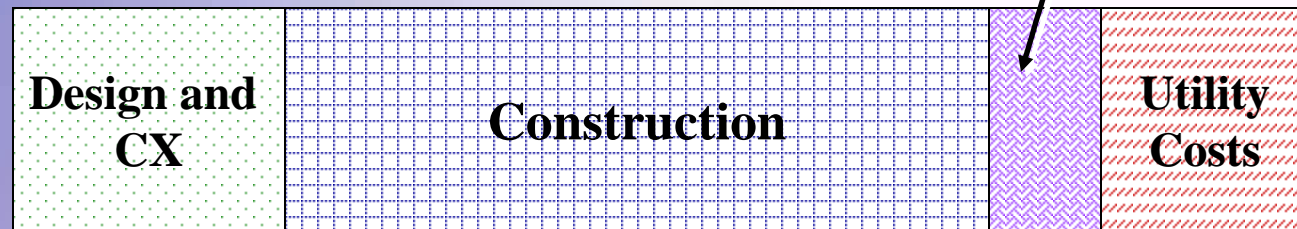
# Commissioning Benefits

Without  
Commissioning



Callbacks/  
Follow-Up

With  
Commissioning



Project Costs →

**Construction costs are not increased, only shifted.**  
**Overall project costs are reduced.**





# OEMC Boilers

---

Questions?  
Discussions?



# OEMC Boilers

# Thanks

**E Cube Inc.**